

Claims

1. A fastener for releasably securing a first element to a second element in a spaced-apart relationship, the fastener including:

5 (a) a locking pin moveable between a locked position in which the first element is secured in spaced relationship to the second element and a release position in which the first element is released from the second element, the locking pin having an engageable head;

(b) means for engaging the head of the locking pin with the second element;

(c) bias means urging the locking pin to the release position; and

10 (d) an actuator comprising or including shape memory alloy adapted to elongate upon application of appropriate energy;

wherein the actuator is adapted, when elongated, to cause the locking pin to move to the release position.

2. The fastener of claim 1, which also includes an integrated processor, a switch
15 and one or more sensors.

3. The fastener of claim 2, in which the sensor is adapted to sense whether the locking pin is in the locked position or the release position.

4. The fastener of claim 3, in which the sensor includes micro switches adapted to be activated by the locking pin or an extension of the locking pin.

20 5. The fastener of any one of any one of claims 1 to 4, wherein the locking pin is made of polymeric material.

6. The fastener of any one of claims 1 to 5, wherein the locking pin has an internal cavity adapted to receive a guide pin.

7. The fastener of any one of claims 1 to 6, wherein the means for engaging the head of the locking pin with the second element comprises or includes a clip.
8. The fastener of claim 7, wherein the clip is annular.
9. The fastener of claim 7 or 8, wherein the clip is in two or more parts.
- 5 10. The fastener of any one of claims 7 to 9, wherein the clip is made of elastic material.
11. The fastener of any one of claims 1 to 10, wherein the locking pin is adapted to be held in the locked position by engagement of the head of the locking pin by the engagement means.
- 10 12. The fastener of claim 11, wherein the locking pin is adapted to move to the release position after disengagement of the head of the locking pin from the engagement means.
13. The fastener of any one of claims 1 to 12 when assembled onto the first element.
14. The fastener of any one of claims 1 to 13, wherein the bias means urging the locking pin to the release position is a coiled spring.
- 15 15. The fastener of any one of claims 1 to 14, wherein the actuator is a single coiled spring made of shape memory alloy.
16. The fastener of claim 15, wherein the actuator is adapted to elongate by energy provided from an energy source.
- 20 17. The fastener of claim 16, wherein there is a cable connection between the energy source and the actuator.
18. The fastener of claim 16, wherein the energy is in the form of infra red light or ultrasound.

19. The fastener of any one of claims 1 to 18, wherein the locking pin is adapted to default to the locked position.
20. The fastener as claimed in any one of claims 1 to 19, which includes a second actuator.
- 5 21. The fastener of claim 20, wherein the second actuator comprises or includes shape memory alloy adapted to elongate upon application of appropriate energy to cause the locking pin to move to the locked position.
22. The fastener of any one of claims 1 to 21, which includes a detent adapted to hold the locking pin in the locked and/or release position.
- 10 23. The fastener of claim 22, wherein the detent is adapted to clip into a groove in the locking pin when the locking pin is in the release position, the engagement between the detent and the groove being adapted to prevent the locking pin moving towards the locked position without positive actuation.
24. The fastener of any one of claims 1 to 19, wherein the locking pin is adapted to move from the locked position to the release position irreversibly.
- 15 25. The fastener of any one of claims 1 to 19, wherein the actuator is adapted to cause the locking pin to move to the locked position when no longer elongated.
26. The fastener of any one of claims 1 to 25, which also includes means to communicate with at least one slave fastener.
- 20 27. The fastener of claim 26, wherein the communication means is adapted to communicate with the slave fastener when the locking pin has been caused to move to the release position.
28. The fastener of any one of claims 1 to 27, wherein the fastener has an address.
29. The fastener of claim 28, wherein the address is encrypted.

30. The fastener in any one of claims 1 to 29, wherein the fastener includes means for enabling the fastener to recognise an authorised operator.
31. The fastener of any one of claims 1 to 30, wherein the locked pin is adapted to be moved to the release position manually.
- 5 32. A fastener assembly for releasably securing an element, the element including a post or pin having a groove, the assembly including a bar adapted to engage the groove to secure the element, the assembly also including a connecting means attached to the bar and consisting of or including shape memory material which, upon application of suitable energy, is adapted to change shape and draw the bar out of engagement with the groove, thus releasing the element.
- 10 33. The fastener assembly of claim 32, wherein the element has more than one post or pin, each having a groove.
34. The fastener assembly of claim 33, wherein the bar is adapted to engage the groove in more than one post or pin.
- 15 35. The fastener assembly of claim 34, wherein the bar engages the groove in each of two posts or pins.
36. The fastener assembly of any one of claims 32 to 35, wherein the connecting means is a shape memory wire.
- 20 37. The fastener assembly of claim 36, wherein the shape memory wire is a titanium-nickel wire.
38. The fastener assembly of claim 36 or 37, wherein the connecting means is attached to each end of the bar and is adapted to change shape by shrinking to draw the bar out of engagement with the groove.
- 25 39. The fastener assembly of any one of claims 32 to 38, wherein the bar is biased into engagement with the groove.

40. A fastener assembly substantially as herein described with reference to Figures 12 to 15 or 16 to 18 of the accompanying drawings.
41. A fastener for releasably securing an airbag between a base and a cover, the fastener including:
 - 5 (a) a locking pin moveable between a locked position in which the base is secured in spaced relationship to the cover and a release position in which the base is released from the cover, the locking pin having an engageable head;
 - (b) means for engaging the head of the locking pin with the cover;
 - 10 (c) bias means urging the locking pin to the release position; and
 - (d) an actuator comprising or including shape memory alloy adapted to elongate upon application of appropriate energy,
wherein the actuator is adapted, when elongated, to cause the locking pin to move to the release position.
- 15 42. The fastener of claim 41, which also includes an integrated processor, a switch and one or more sensors.
43. The fastener of claim 42, in which the sensor is adapted to sense whether the locking pin is in the locked position or the release position.
44. The fastener of claim 43, in which the sensor includes micro switches adapted to
20 be activated by the locking pin or an extension of the locking pin.
45. The fastener of claim 41 which also includes a sensor adapted to sense and report the presence or absence of the airbag.
46. The fastener of any one of any one of claims 41 to 45, wherein the locking pin is made of polymeric material.

47. The fastener of any one of claims 41 to 46, wherein the locking pin has an internal cavity adapted to receive a guide pin.
48. The fastener of any one of claims 41 to 47, wherein the means for engaging the head of the locking pin with the cover comprises or includes a clip.
- 5 49. The fastener of claim 48, wherein the clip is annular.
50. The fastener of claim 48 or 49, wherein the clip is in two or more parts.
51. The fastener of any one of claims 48 to 50, wherein the clip is made of elastic material.
52. The fastener of any one of claims 41 to 51, wherein the locking pin is adapted to 10 be held in the locked position by engagement of the head of the locking pin by the engagement means.
53. The fastener of claim 52, wherein the locking pin is adapted to move to the release position after disengagement of the head of the locking pin from the engagement means.
- 15 54. The fastener of any one of claims 41 to 53 when assembled onto the base.
55. The fastener of any one of claims 41 to 54, wherein the bias means urging the locking pin to the release position is a coiled spring.
56. The fastener of any one of claims 41 to 55, wherein the actuator is a single coiled spring made of shape memory alloy.
- 20 57. The fastener of claim 56, wherein the actuator is adapted to elongate by energy provided from an energy source.
58. The fastener of claim 57, wherein there is a cable connection between the energy source and the actuator.

59. The fastener of claim 57, wherein the energy is in the form of infra red light or ultrasound.

60. The fastener of claim 57, wherein the energy source is a vehicle battery.

61. The fastener of any one of claims 41 to 60, wherein the locking pin is adapted to 5 default to the locked position.

62. The fastener as claimed in any one of claims 41 to 61, which includes a second actuator.

63. The fastener of claim 62, wherein the second actuator comprises or includes 10 shape memory alloy adapted to elongate upon application of appropriate energy to cause the locking pin to move to the locked position.

64. The fastener of any one of claims 41 to 63, which includes a detent adapted to hold the locking pin in the locked and/or release position.

65. The fastener of claim 64, wherein the detent is adapted to clip into a groove in 15 the locking pin when the locking pin is in the release position, the engagement between the detent and the groove being adapted to prevent the locking pin moving towards the locked position without positive actuation.

66. The fastener of any one of claims 41 to 60, wherein the locking pin is adapted to move from the locked position to the release position irreversibly.

67. The fastener of any one of claims 41 to 60, wherein the actuator is adapted to 20 cause the locking pin to move to the locked position when no longer elongated.

68. The fastener of any one of claims 41 to 67, which also includes means to communicate with at least one slave fastener.

69. The fastener of claim 68, wherein the communication means is adapted to 25 communicate with the slave fastener when the locking pin has been caused to move to the release position.

70. The fastener of any one of claims 41 to 69, wherein the fastener has an address.
71. The fastener of claim 70, wherein the address is encrypted.
72. The fastener of any one of claims 41 to 71, wherein the fastener includes means for enabling the fastener to recognise an authorised operator.
- 5 73. The fastener of any one of claims 41 to 72, wherein the locked pin is adapted to be moved to the release position manually.
74. A fastener substantially as herein described with reference to Figures 1 to 3 or 4 or 5 to 9 or 10 to 11 of the accompanying drawings.
75. A method of installing an airbag between a base and a cover, the method including the steps of:
 - (a) connecting at least one fastener as claimed in any one of claims 41 to 74 to the base;
 - (b) connecting the airbag to the base; and
 - (c) causing the locking pin to move to the locked position to secure the airbag between the base and the cover.
- 15 76. The method of claim 75 in which steps (a) and (b) are reversed.
77. The method of claim 75 or 76, which includes the further step of connecting each fastener to wiring for the airbag.
78. The method of claim 77, wherein the airbag wiring is connected to an engine control unit.